

RESEARCH REPORT and IMPLEMENTATION

STAP Number N/A	Contract Number 59A0188	Performance Period 5/1/2000-4/30/2004
Title Composites for Bridge Program		
Report Date, No., & Title December 30, 2003 ATR-2004(7796)-1 Development of Machine Augmented Composite for Infrastructure Applications February 25, 2005 ATR-2005(7796)-1 The Application of Qualification Testing, Field Testing, and Accelerated Testing for Estimating Long-Term Durability of Composite Materials for Caltrans Applications April 20, 2005 ATR-2005(7796)-2 Using Composites in Seismic Retrofit Applications		
Principal Investigator Dr. G. F. Hawkins		Research Institution Aerospace Corporation
Abstract Caltrans has begun utilizing composite materials in several bridge applications. Formal procedures for the evaluation and qualification of composite casings for seismic retrofit of bridge columns were adopted in 1995 and are being applied to all structural applications of composite materials. Environmental durability testing to ensure the long-term integrity of composite structures is an integral part of the qualification process. The Aerospace Corporation had supported Caltrans in the original development of pre-qualification requirements of composite column casing for seismic retrofit application. To further developing durability of FRP composite material, Caltrans contracted with the Aerospace to perform qualification durability testing on composite materials used in the construction of the Kings Stormwater Bridge and to conduct research activities related to the durability of composites for infrastructure applications. Research areas included a field durability study conducted at the Yolo Causeway to help define the field environment, and to compare durability in the field environment with the results of the qualification test program. A shortcoming of the qualification program was the inability to make long-term (30~50 yrs.) tensile strength projections from the relatively short-term (1.14 yrs.) exposure data for those systems that showed susceptibility in moist environments. Post exposure tensile strength data from accelerated exposures at an elevated temperature and significantly longer term (6.3 yrs.) laboratory exposures under the qualification conditions were combined with the qualification test data to develop expressions for making long-term tensile strength projections under service conditions. The Aerospace Corporation not only assists Caltrans in construction inspection, they also act as expert witness during litigation in contract claim. This research project includes: Task 1: Determining the Durability of New System Task 2: Research on Construction procedures Task 3: Machine Augmented Composite Task 4: Development of Portable Glass Transition Temperature Device		
Achievement Task 1: Determining the Durability of New System Performed durability tests on carbon/epoxy system from the Kings Stormwater Bridge girder as well as E-glass/Epoxy Vinyl Ester bridge deck elements. Continue durability tests on material samples left from previous pre-qualification test and field samples. Task 2: Research on Construction procedures Performed QC/QA during the construction on the construction of Arroyo Seco Bridge retrofit. Acts as expert witness during contract claim and litigation. Task 3: Machine Augmented Composite Develop and evaluate feasibility to design and manufacture high damping composite material. A wedge like composite also developed for laminated composite anchorage. Task 4: Development of Portable Glass Transition Temperature Device Two prototypes TG-tester were developed and evaluated. They were calibrated against other types of TG testing equipment in the laboratory and found reliable. The latest prototype was used as QC/QA tool at FRP composite deck manufacture site and Caltrans FRP composite jacket demonstration site.		

<p>Conclusion & Recommendation</p> <p>Task 1: Determining the Durability of New System The longest durability test concluded that the material modulus did not varied after 6 years, the same as previous finding during pre-qualification program.</p> <p>Task 2: Research on Construction procedures Performed QC/QA during the construction on the construction of Arroyo Seco Bridge retrofit. Acts as expert witness during contract claim and litigation.</p> <p>Task 3: Machine Augmented Composite Machine augmented high damping material is not economical as too much manufacture issue and size involve. However, the wedge like anchorage seems to be more promising if it can be verified on large concrete specimen.</p> <p>Task 4: Development of Portable Glass Transition Temperature Device It will be beneficial if such device is available commercially. Current prototype is too fragile to use.</p>	
<p>Contract Manager</p> <p>Li-Hong Sheng</p>	<p>Technical Support Team</p> <p>FRP Composite Technical Committee Jim Gutierrez, Pat Hipley</p>
<p>Implementation Recommendation</p> <p>9/01/2005</p> <p>Task 1: Determining the Durability of New System Update FRP composite material properties table in alternative column casing specification based on research conclusion.</p> <p>Task 2: Research on Construction procedures Update alternative column casing specification based on experiences learned from construction QC/QA.</p> <p>Task 3: Machine Augmented Composite Need to verify performance of wedge anchor devices on FRP material used on girder rehabilitation.</p> <p>Task 4: Development of Portable Glass Transition Temperature Device The portable TG-Test should be used as QC/QA tool during construction if commercially available. Continue search NDE devices for construction QC/QA.</p>	
<p>Implementation Measure Taken</p> <p>Task 1: Determining the Durability of New System 9/1/2005 Current FRP material table in alternative column casing is based on mean plus 2 sigma for strength and mean plus 3 sigma on modulus. The research result did not affect those values. However, the long term durability data can be used to evaluate future design reduction factor on superstructure rehabilitation.</p> <p>Task 2: Research on Construction procedures 10/1/2005 Standard plan on alternative column casing of system 1 was revised to give more direct information on jacket thickness.</p> <p>Task 3: Machine Augmented Composite N/A.</p> <p>Task 4: Development of Portable Glass Transition Temperature Device N/A.</p>	